SOUTH FLORIDA ECOSYSTEM RESTORATION

Hanley K. Smith
US Army Corps of Engineers
P. O. Box 4970
Jacksonville, Florida 32232-0019

I have two purposes in my talk today: I want to make you aware of a huge ecological restoration project underway in south Florida, and I want to leave you with three ecological principles that should be considered in all restoration activities. Those principles are: there is no free lunch; everything is connected to everything else; and, diversity is the key to survival.

Lets start with a trip to my home state and a look at the world's largest ecological restoration project (Fig. 1). We call this the restoration of the Everglades, but it's really restoration of a much larger system that includes the Everglades and its entire watershed. I'll try to spare you too much geography, but you'll hear me mention the Kissimmee River, Lake Okeechobee, the Everglades and Florida Bay. The headwaters of the system is near Orlando, very close to Disney World. Water flows southward in the Kissimmee River and enters Lake Okeechobee. That water leaves the lake and continues southward into a marsh about 140 kilometers long and up to 60 kilometers wide. Ultimately water flows out the southern end of the state into Florida Bay. The whole area is very flat and it takes about a year for water to go from Lake Okeechobee to Florida Bay. The Everglades proper typically ranges from a few inches to a few feet deep and is often called the River of Grass (Fig. 2).

About 100 years ago the State decided to drain this huge wetland by digging canals from the lake to the Atlantic Ocean and the Gulf of Mexico (Fig. 3). These canals did in fact drain the area, encouraged agriculture, and caused some major problems. The canals caused over-drainage and during dry periods, saltwater came up the canals and threatened to salt out the surface aquifer. The soils in some of this region are organic and when they were dry they frequently caught fire and burned. The canals offered little flood protection, and many people who had moved into the area to farm it were threatened by flooding from hurricanes.

In the 1940s the state and Federal government began a project to solve the problem (Fig. 4). The project literally made south Florida livable for millions of people: it secured the water supply and provided flood control. It also preserved nearly 1.5 million hectares in their natural state. It is by any measure an amazing project. Thousands of kilometers of canals, levees and pump stations extend across both wilderness and heavily settled areas. For its time, the 1940s, it was a model of environmental sustainability. But there are problems. The project is not providing the natural resource benefits that Floridians expect. There are major sport and commercial fisheries in both Lake Okeechobee and Florida Bay that are endangered by changes that the project has contributed to. Part of our natural heritage is also at great risk. Many people in Florida have profoundly held concept that they live on the edge of a huge wilderness. Even though most haven't seen it personally, they know that the area supports many rare species like the manatee, Florida panther, alligator and wading birds. They also know that these animals are in great peril, that their numbers have crashed in the last few decades. They want the system fixed, but they also want the benefits that the system provides: water supply and flood control. So that's the problem, how to restore the animal populations and still provide the water resource benefits to the 6 million people who live on the system's eastern edge.

Imagine the condition of the Everglades before we started to move the water around for our own benefit. It was a continuous 300 kilometer wetland with a slow flow beginning near Orlando and working its way slowly down the meandering Kissimmee River and into the Lake Okeechobee. When was high it overflowed its banks and water entered the Everglades proper and then worked its way slowly down the remaining 150 kilometers to Florida Bay.

We converted the meandering Kissimmee River into a deep, wide canal that moves water quickly off adjoining pasturelands and into Lake Okeechobee. The lake is surrounded by a high levee, and the water level is regulated to meet flood control, water supply and environmental needs. Immediately below the lake is a 300,000 hectare agricultural area that adds damaging agricultural nutrients. To the south lie 1.3 million hectares of marsh. Levees and canals crisscross the marsh, and gravity flow and pump stations move water around. Water is moved around the system in part to

accommodate the natural environment; however, during times of heavy rain, floodwater is diverted into the Everglades making flooding worse for the plants and animals living there. During drought water is diverted out of the Everglades to meet human population needs to the east, making the drought in the Everglades much worse.

Now, please bear with me as I shift gears, and go back to the ecological principles that are key to restoration. Remember: no free lunch; everything is connected; diversity is the key to survival.

Don't expect nature to provide a free lunch. Every action we take has a response. If one thing in my 30 year career as an ecologist has surprised me it is that the reaction of the natural environment to disturbance is always greater than predicted. The question we should be asking before we disturb a natural system is: are we willing to pay the price, both biologically and economically? The cultural and biological price we paid in the Everglades was the near loss of a natural treasure. Restoration is much more difficult and much more expensive than the original project. It's costing us conservatively 10 times more to restore a system than it cost to damage it. Everything we do to alter a natural system has consequences—some good, like flood protection, some bad, like loss of a fishery. There is truly no free lunch.

The second principle is that everything is connected to everything else. Sometimes we call this the web of life. Even minor alterations have consequences, and what we did to the Everglades was not minor. Channelizing a river as we did to the Kissimmee has the consequence of creating a hydraulically efficient system, and that's what you want for flood control. But almost all of the biological energy of the river came from the floodplain, and when the hydrologic connection between the meandering river and the floodplain was broken, that energy source for the river was lost. There are thousands of examples in the Everglades where natural system connectivity has been lost. Part of the answer to restoring this system is reconnecting all the parts. The physical reconnection, filling in canals for example, is the easy part.

On to my final ecological principle: diversity is the key to survival. A natural system is very diverse hydrologically, biologically, and chemically. There's a temptation to call nature chaotic and disorganized, but that's purely a human concept. The truth is natural systems are intricately designed to survive. When we simplify a system hydrologically, when we establish flood control in order to move water around in an orderly and predictable way, we destroy that system's diversity. That weakens the system's ability to survive. The hydrology of the Everglades has been simplified to meet our flood control and water quality needs, and the result is a loss of diversity and the creation of a system that is on the verge of ecological failure. Fire, flood and drought are all part of the natural world, and healthy ecosystems respond to these disturbances in a healthy way, often by becoming even more vigorous. But in a less diverse system disturbance becomes catastrophe. Fire, flood and drought simply weaken a weakened system even more. And what we have in the Everglades today is an ecosystem that's unable to respond to disturbance without loss of function. Fire and flood here push even more species toward extinction.

Now let's go back and tie these principles into what we're doing to restore the Everglades. I've described the problem—channelized rivers; lakes regulated like reservoirs, lots of habitat lost permanently to urban and agricultural uses, water quality problems throughout, and an unnatural movement of water throughout the Everglades. A hydrologically simplified and altered ecosystem. What to do about it? Briefly, the plan resotres the natural hydrology as much as possible while keeping the flood control and water supply functions in place. The plan also focuses on improving water quality-especially in eliminating runoff of agricultural nutrients.

Starting in the northern portion of the basin, we find the channelized Kissimmee River. We are now filling the channel, removing locks and dams and reconnecting old river meanders. This will increase the amount and duration of flooding, which will reconnect the river with an active floodplain. There are very few homes here, the land is mostly used for pasture, and landowners who are adversely impacted will be compensated.

Lake Okeechobee will be operated more like a natural lake and less like a reservoir. Mostly that means the lake will be lowered and floodwaters won't be stored to an extent greater than you would expect without any control.

About 15,000 hectares of the 300,000 hectare agricultural area below Lake Okeechobee is being developed into marshes to treat and remove agricultural nutrients. Thus runoff will be treated before it reaches the Everglades proper.

There are three major hydrologic problems in the Everglades proper. First there is not enough water to meet both environmental and water supply needs, because of excession losses to the ocean via canals. The plan is to increase the amount of water available by storing as much water as possible in new reservoirs and aquifer storage areas. Second, water is presently moved around in canals and by pump stations. The plan is to remove as many of the canals as possible and allow more water to move around by sheet flow. Finally and probably most important we plan provide water in a natural flow regime: the right amount at the right time and in the right place.

That brings me to the conclusion. We have determined that by restoring the natural hydrology to the Everglades we can restore many broken connections and restore much of the area's diversity. We will never completely restore this basin. Far too much has been lost permanently. But we can make a big improvement and rescue the area from certain destruction. There have been many benefits to our activities in the basin, we made this area livable for 6 million people. But there was great environmental damage-far beyond our ability to have quessed years ago. There is indeed no free lunch. Adding to the cost of lunch, the cost of restoration is high-conservatively $10 billion. In many ways the Everglades is a test case for environmental restoration worldwide. The concept will only be successful if it has public acceptance, government resolve, and a strong science base. Having worked for ten years to untie this knot I have to leave you with this final thought: restoration is very difficult and very expensive. The most rational approach is to avoid damage in the first place.

Fig. 1. The Everglades watershed extends from Orlando to Florida Bay. The Everglades proper is a broad marsh that once included much of Florida south of Lake Okeechobee.

Fig. 2. Typical scene in the Everglades, an extensive sawgrass marsh with scattered tree islands.

Fig. 3. By the 1920s canals had been dug to drain the northern part of the Everglades.

Fig. 4. The Central and South Florida Flood Control Project manages water movement in the Everglades. It was begun in 1950 and essentially complete in the 1970s.